The Patent Office

INVESTOR IN PEOPLE

The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.

Signed

Dated 10 February 2005

Patents Form 1/77

Patents Act 1977
(Rule 16)

26 SEP 2003

The Patent Office

THE PATENT OFFICE
D
26 SEP 2003
LONDON

1/77

29SEP03 E840430-1 D02732
P01/7700 0.00-0322659.4

The Patent Office

Cardiff Road
Newport
South Wales
NP9 1RH

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

1. Your reference	A1592
2. Patent application number *(The Patent Office will fill in this part)*	0322659.4
3. Full name, address and postcode of the or of each applicant *(underline all surnames)*	ABERDEEN UNIVERSITY RESEARCH AND INNOVATION UNIVERSITY OFFICE KINGS COLLEGE ABERDEEN AB24 3FX UNITED KINGDOM
Patents ADP number *(if you know it)*	08642183001
If the applicant is a corporate body, give the country/state of its incorporation	
4. Title of the invention	SUPPORT PANEL
5. Name of your agent *(if you have one)* "Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*	ABLETT & STEBBING CAPARO HOUSE 101-103 BAKER STREET LONDON W1U 6FQ
Patents ADP number *(if you know it)*	00006551001 ✓

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number	Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application	Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*
a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

YES

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	0
Description	9
Claim *(s)*	2
Abstract	0
Drawing *(s)*	7 + 7 8

10. If you are also filing any of the following, state how many against each item.

Priority documents	0
Translations of priority documents	0
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	0
Request for preliminary examination and search *(Patents Form 9/77)*	0
Request for substantive examination *(Patents Form 10/77)*	0
Any other documents *(please specify)*	0

11. I/We request the grant of a patent on the basis of this application.

Signature — Date

ABLETT & STEBBING — 26 September 2003

12. Name and daytime telephone number of person to contact in the United Kingdom — G K ABLETT / S J SUÈR — 020-7935-7720

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

a) If you need help to fill in this form or you have any questions, please contact the Patent Office on 0645 500505.

b) Write your answers in capital letters using black ink or you may type them.

c) If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.

d) If you have answered 'Yes' Patents Form 7/77 will need to be filed.

e) Once you have filled in the form you must remember to sign and date it.

f) For details of the fee and ways to pay please contact the Patent Office.

SUPPORT PANEL

The present invention relates to support panels and in particular multi-function open or otherwise permeable panels for providing one or more of structural support, enhanced uniform airflow, edge termination, sealing and enhancing alignment, in relation to permeable media. Such media may be structurally weak (i.e., not self-supporting) dynamic insulation media when applied to breathing buildings and structures.

In this regard, a revolutionary breathing wall cladding technology and multiplicity of modular cladding panel designs that use fibre-based and other dynamic insulation media, to achieve up to 30% energy savings above current conventional insulation standards, have been developed by the present applicant. As outdoor air is drawn into the building through one or more layer(s) of dynamic insulation, contra-flow heat exchange occurs and heat normally lost through conduction is instead used to preheat ventilation air.

Important outcomes of this are greatly improved thermal insulation performance and enhanced indoor air quality, where high fresh-air ventilation rates can henceforth be achieved without the penalty of excessive energy consumption using simple HVAC plant. Equally important, the cladding panels filter particulates and other forms of airborne pollution to HEPA standards for the life of the building (60+ years) to protect building occupants from harm, and in the process clean up the outdoor environment.

Such breakthroughs in wall-cladding technology require

knowledge of how to design and build dynamically insulated breathing buildings or structures that are optimised for performance, quality, durability and longevity. Specifically, the dynamic insulation component of the cladding needs to deliver low energy consumption, high indoor air quality and outstanding filtration performance without premature clogging for the life and location of the building or structure. The result is a new type of building or structure that achieves direct, intimate, responsive coupling between the indoor and outdoor environments via a cladding system that enhances air quality and energy efficiency without sacrificing functionality or occupant safety.

For dynamic insulation to function optimally it is necessary for incoming ventilation air to flow uniformly through the largest possible area of a building's or structure's breathing envelop, but for infiltration or leakage flows through gaps, cracks, leaky doors and windows, etc., to be reduced to a minimum, or eliminated. Fibre-based and many other air permeable dynamic insulation media are generally not self-supporting (i.e., they are weak structurally), making their precise placement and long-term size stability and fixity within the cladding panel or system problematic. In addition it is difficult, if not impossible, to achieve a seamless, airtight joint between such materials and the rigid encapsulating structures used in a cladding panel or system. Finally, any occlusion of airflow through the inlet and outlet faces of fibre-based dynamic insulation media, for example by external bracing, would reduce the effective face area and degrade performance.

In this regard, examples of the present invention will be described below with reference to the drawings, of which:-

Figure 1 shows in plan view and part-sectional view panel geometry of the present invention;
Figure 2 shows panel geometry in a 5 by 5 cell sample;
Figure 3 shows sections through core dynamic insulation elements of the present invention;
Figures 4 to 6 show results of testing in relation to the present invention; and
Figure 7 shows a cross-sectional view of a cladding arrangement incorporating the present invention.

As shown in Figures 1 and 2, the present invention provides a simple and elegant solution to the above mentioned and other problems. In particular, one or more relatively rigid panel(s) 1 form a regular geometric pattern of truncated (open) or otherwise permeable outward-facing nodes 2 and pointed inward-facing anti-nodes 3 to grip into fibre-based dynamic insulation media 4. The dimensions are scalable and fabrication material choice wide, but the geometry of the support / encapsulation panels is very specific. A representative partial sample of a single panel is depicted in Fig. 1 and 2.

Turning to Figure 3, this figure describes two possible embodiments of a core dynamic insulation element for a multitude of external wall, roof or floor types forming parts of the envelope of a breathing building or structure.

Single and twin/mirrored panel(s) 1 encapsulating a layer(s) of dynamic insulation media 4 are shown in the 2-D schematics in Fig. 3. In core element (b) the truncated nodes 2 from a mirror pair of aligned encapsulating panels 1 provide the outward-facing openings through which air flows uniformly through the media 4, and inward-facing pairs of

pointed anti-nodes 3 that grip the dynamic insulation without occluding the faces of the media. Also noteworthy is the shape of each cell pair 5, which acts as diffusion-contraction unit to enhance uniformity of the airflow entering the cell and passing through the media. Such cell pairs form a repeating structure that, together with the finite value of permeability of the media ensures good uniformity of flow through the core element, irrespective of what inlet/outlet conditions are imposed. Thus, where the air is introduced into the wall panel and/or where it is extracted from the panel would, in practice, have little or no detrimental effect on flow uniformity through the media.

This uniquely desirable behaviour is demonstrated in the CFD results in Figs. 4, 5 and 6, obtained for a ventilated rainscreen-cladding panel incorporating such a dynamic insulation core element. Results for core element (a), employing a single panel over the inlet face of the media, should be nearly as good.

With reference to Figs. 4 and 5, outdoor air is drawn into the cladding panel when the breathing building in which it is fitted is depressurised. The air queues up in the gap between the rainscreen and core cladding element (the inlet plenum), flows uniformly through the dynamic insulation media and thereafter fills the space behind the internal wall skin (the outlet plenum) before being dumped, preheated and filtered, into the room or air handling system. The inlet vent of the cladding panel in this particular case was located at the bottom, and the outlet vent at the top. This results in the very flat (less than 2% variation) velocity profile through the encapsulated dynamic insulation media shown in Fig. 6. Similar results were obtained for mid-

height vents, directly opposing vents, and many other variations of inlet/outlet vent location, inlet/outlet plenum size, etc., thus ensuring optimum performance irrespective of where the inlet and outlet vents are located. In each and every case examined all of the breathing wall area was effectively utilised, freeing the breathing building designer of all of the constraints and limitations previously associated with this form of construction.

The particular geometry of the supporting/encapsulating panels that form part of the core dynamic insulation cladding element shown in Figs. 1 and 2 will henceforth be referred to as diamond lattice, since the planes forming this geometry have a diamond-shaped profile. Variations on this geometry, for example using curved surfaces (i.e., cones instead of pyramids) to achieve similar functionality are possible. The cells of the lattice are uniformly arrayed along length and width dimensions by design. Thus any desired size of breathing wall area and insulation thickness can be cut and manufactured from generic, standard-size panels, using a generic, thermally-isolating edge termination and sealing scheme such as that illustrated in 2-D in Fig. 7. This feature enables a wide range of dynamic insulation cladding panel sizes and specifications to be achieved using a single generic panel type, and matching generic sealing/termination strip, with all the advantages that this brings from a manufacturing perspective. It also means that the core dynamic insulation element can be readily used in traditional and retrofit building projects as a straight, slot-in replacement for conventional insulation. Inlet and outlet plenums and vents through exterior envelope walls will naturally be required, and a means of depressurising the building to induce ventilation airflow found in order to

achieve breathing building functionality.

The diamond lattice panel(s) and associated peripherals (vents, plenums, edge termination, sealing, etc.) represent a crucially important development in breathing wall cladding technology and design. They enable (i) uniform airflow through a large breathing wall area, and (ii) in-room air movement and distribution to be achieved easily and efficiently.

The present invention hence provides multi-function open or otherwise permeable panel(s) that provide structural support, or facilitates uniform airflow, edge termination, sealing, alignment, etc., or any combination thereof, for permeable media and in particular, but not solely restricted to, structurally weak (i.e., not self-supporting) dynamic insulation media.

The multi-function panel(s) minimise occlusion of airflow through the inlet face of fibre-based dynamic insulation media to reduce the effective face area or degrade performance.

The multi-function panel(s) seek to enable uniform airflow through a large breathing wall area to be achieved.

The multi-function panel(s) further seek to enable effective in-room air movement and distribution in breathing buildings to be achieved easily and efficiently.

The present invention further provides a revolutionary breathing wall cladding technology and multiplicity of modular cladding panel designs, including but not restricted

to ventilated rainscreen designs, that uses fibre-based and other structurally weak dynamic insulation media, supported and/or encapsulated by the aforementioned multi-function panel(s) to achieve significant energy savings, air filtration and/or high indoor air quality.

The present invention provided one or more multi-function panel(s) formed in a geometrical pattern of truncated (open) or otherwise permeable outward-facing nodes and pointed insulation-facing anti-nodes, as illustrated in Figs. 1 and 2, to freely support and/or encapsulate fibre-based and/or any other structurally-weak dynamic insulation media.

Further, the present invention provides any number of multi-function panel(s) encapsulating a layer(s) of dynamic insulation media as shown in the 2-D schematics in Fig. 3, henceforth referred to as core dynamic insulation elements.

The present invention encompasses a core dynamic insulation element(s) as defined above, that may be used for a multiplicity of external wall, roof or floor types forming the envelope of a breathing building or structure, as well as a cladding panel or cladding system employing any core dynamic insulation element.

The present invention further provides a ventilated rainscreen cladding panel design for dynamic insulation where outdoor air is drawn into the cladding panel when the building is depressurised, queues up in the gap between the rainscreen and core cladding element (the inlet plenum), flows uniformly through the dynamic insulation media and thereafter fills the space behind the internal wall skin (the outlet plenum) before being dumped, preheated and filtered,

into the room or air handling system.

The present invention encompasses all variation(s) in geometry of multi-function panel(s) where truncated (open) nodes of any shape or form provide openings through which incoming and outgoing air can flow through the media, and anti-nodes grip the dynamic insulation media at opposing points without occluding the inlet and outlet faces of the media.

The present invention further encompasses all variation(s) in geometry of multi-function panel(s), where the shape of a cell pair enables it to act as a diffusion-contraction unit, to assist in achieving uniformity of airflow entering the cell and passing through the media.

The present invention further encompasses all variation(s) in geometry of multi-function panel(s) where cell pairs form a repeating structure that, together with the finite value of permeability of the media, ensure good uniformity of flow through the core dynamic insulation element irrespective of the inlet / outlet conditions imposed in practice.

The present invention further encompasses specific pyramid-based geometry of multi-function open or otherwise permeable supporting/encapsulating panel(s), forming part of the core dynamic insulation cladding element shown in Figs. 1 and 2, henceforth referred to as diamond lattice, after the planes forming this geometry which have a diamond-shaped profile

Further, the present invention encompasses all variation(s) in geometry of multi-function panel(s), for example using curved surfaces (i.e., cones instead of pyramids) to achieve

similar functionality.

The multi-function panel(s) may be arranged so that the cells of the lattice are uniformly arrayed along length and width dimensions, so that any desired size of breathing wall area and insulation thickness can be cut and manufactured from generic, standard-size panels, using a generic edge-termination and sealing scheme, such as that shown in Fig. 7.

The present invention further encompasses generic, thermally isolating (i.e., non-bridging) edge-termination and sealing method and components shown in Fig. 7.

The multi-function panel(s)of the present invention may be used to support/encapsulate one or more layer(s) of conventional or dynamic insulation media, filtration media, fluid-permeable media, structurally weak media, or any media, or any combination thereof.

The multi-function panel(s) may be used to provide additional functionality through choice of constituent materials, or use of special coatings (e.g. TiO_2 as a NO_x catalyst).

Claims:-

1. An air permeable panel for an intermediate cladding layer having filtering characteristics, said panel comprising:-

a plurality of projections interconnected in a lattice configuration, said projections being arranged to face in a common direction for engagement in use with said intermediate cladding layer.

2. An air permeable panel according to claim 1, wherein the projections have a tip portion and a base portion and are interconnected at or adjacent their respective base portions.

3. An air permeable panel according to claim 1 or 2, wherein said projections have a pyramidal form.

4. An air permeable panel according to any one of claims 1 to 3, wherein the base portions are interconnected with spaces defined therebetween.

5. An air permeable panel according to any preceding claim, wherein the projections are configured to restrict penetration thereof into the intermediate cladding layer.

6. An air permeable panel according to claim 5, wherein the cross-sectional area of each projection increases along its longitudinal axis away from their tip portion.

7. A building cladding system incorporating an air permeable panel according to any preceding claim.

8. A building cladding system according to claim 7, further

comprising a wall member, adjacent the panel and coupled thereto.

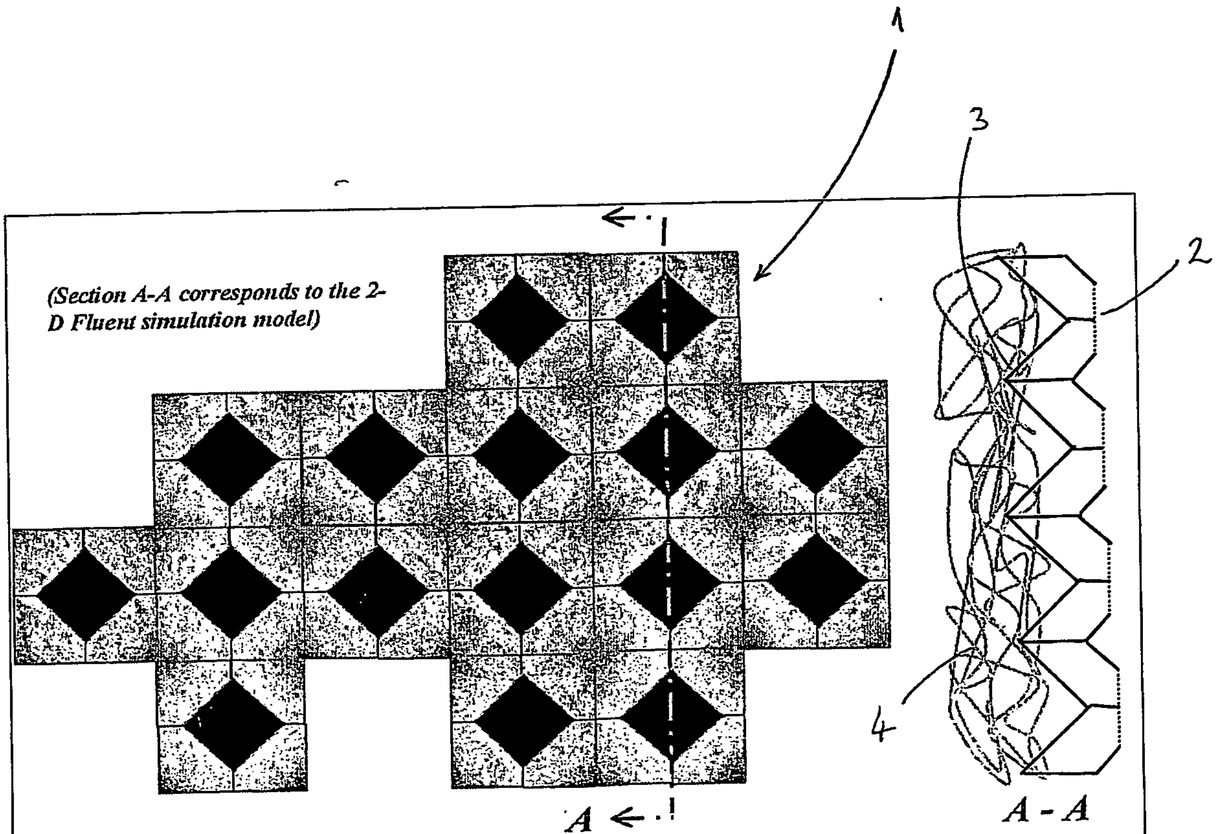
9. A building cladding system according to claim 8, comprising internal and external wall members within which the panel and intermediate cladding layer are provided.

10. A building cladding system according to claim 8 or 9, further comprising one or more edge members, configured to couple the panel to one or both of said wall members and to interconnect adjacent intermediate cladding layers.

11. An air permeable panel substantially as hereinbefore described with reference to the accompanying drawings.

12. A building cladding system substantially as hereinbefore described with reference to the accompanying drawings.

FIGURE 1



Diamond lattice (egg-crate) structure in plan

Note truncated nodal air inlets / outlets (black) and internal anti-nodal spikes (dark grey)

FIGURE 2

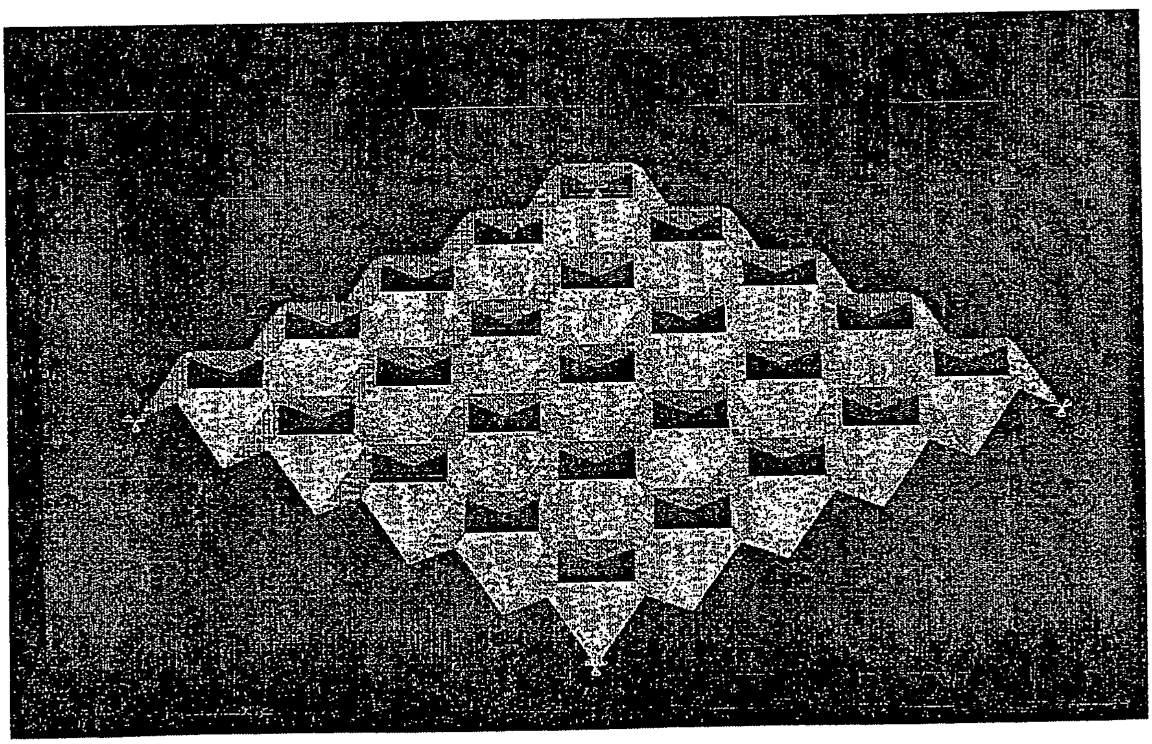
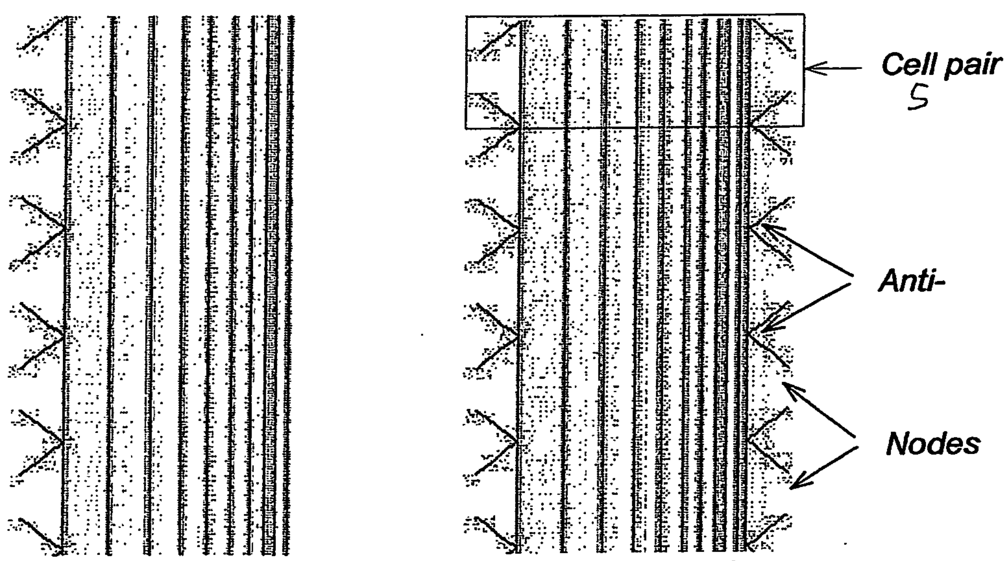
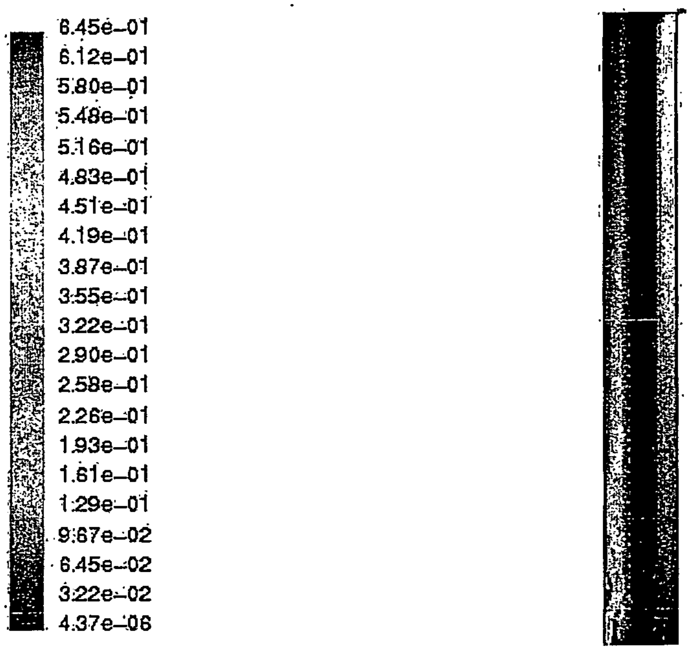


FIGURE 3



(a) single panel (b) mirror panels

FIGURE 4

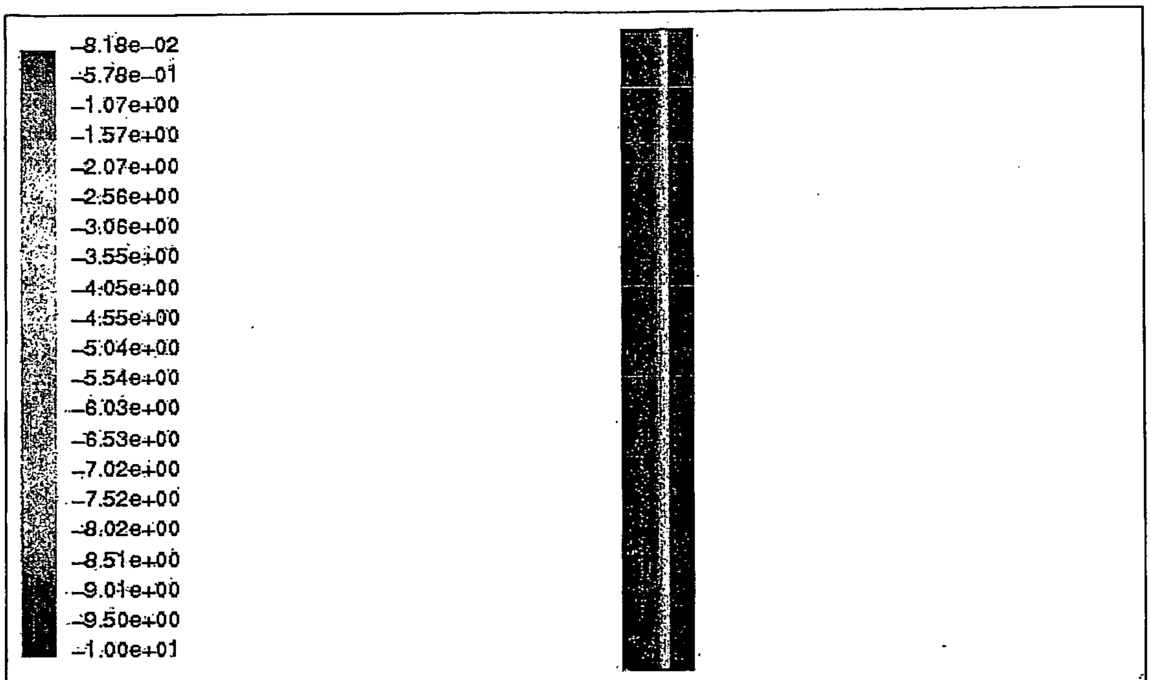


Velocity Vectors Colored By Velocity Magnitude (m/s)

FLUENT 6.0 (2d, segregated, lam)

5/7

FIGURE 5

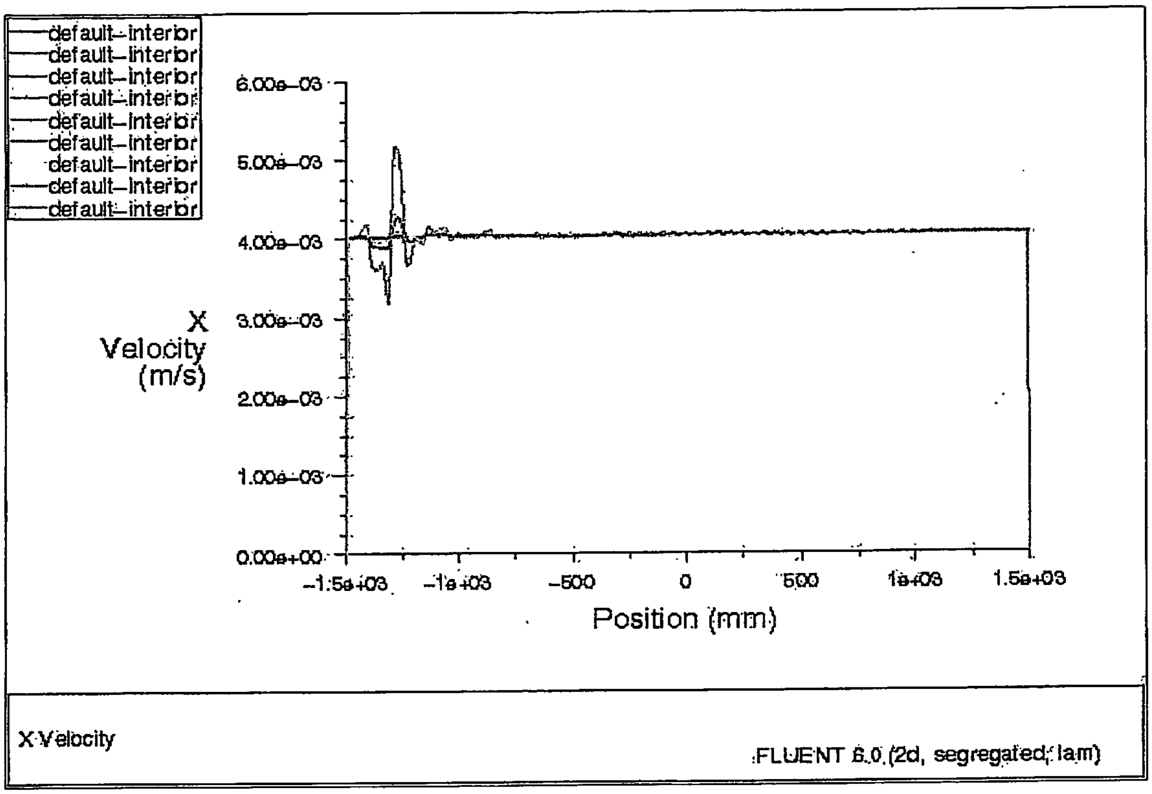


Contours of Static Pressure (pascal)

FLUENT 6.0 (2d, segregated, lam)

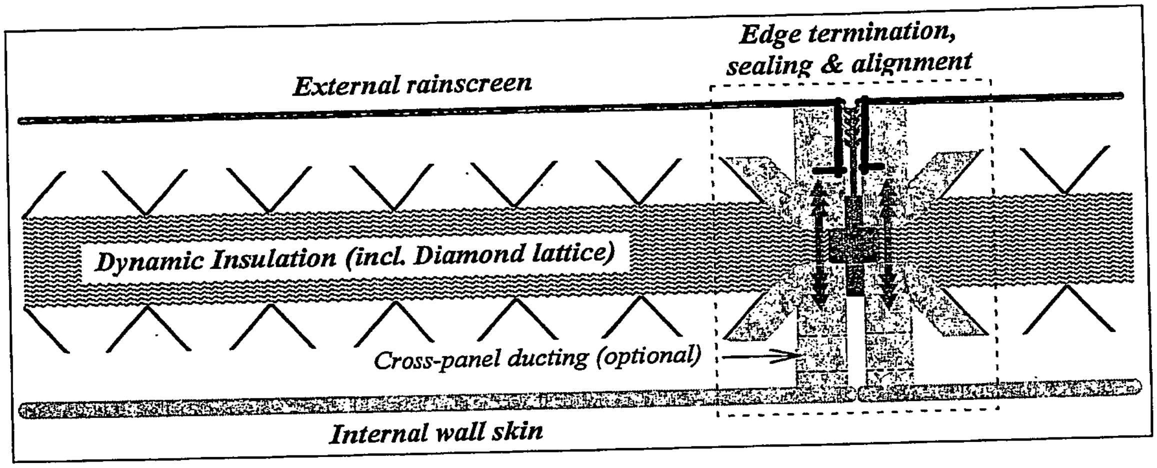
6/7

FIGURE 6


default-interior
default-interior
default-interior
default-interior
default-interior
default-interior
default-interior
default-interior
default-interior
6.00e-03
5.00e-03
4.00e-03
3.00e-03
2.00e-03
1.00e-03
0.00e+00
X Velocity (m/s)
-1.5e+03
-1e+03
-500
0
500
1e+03
1.5e+03
Position (mm)
X Velocity
FLUENT 6.0 (2d, segregated, lam)

7/7

FIGURE 7



Edge termination,
sealing & alignment
External rainscreen
Dynamic Insulation (incl. Diamond lattice)
Cross-panel ducting (optional)
Internal wall skin

Document made available under the Patent Cooperation Treaty (PCT)

International application number: PCT/GB04/004023

International filing date: 22 September 2004 (22.09.2004)

Document type: Certified copy of priority document

Document details: Country/Office: GB
Number: 0322659.4
Filing date: 26 September 2003 (26.09.2003)

Date of receipt at the International Bureau: 21 February 2005 (21.02.2005)

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b)

World Intellectual Property Organization (WIPO) - Geneva, Switzerland
Organisation Mondiale de la Propriété Intellectuelle (OMPI) - Genève, Suisse

This Page is Inserted by IFW Indexing and Scanning Operations and is not part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☑ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☑ FADED TEXT OR DRAWING
- ☑ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☑ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☑ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☐ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: ______________________

IMAGES ARE BEST AVAILABLE COPY.
As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.